

* 5 points each unless the point is indicated in the problem

1 How are plasmids, cosmids, and artificial chromosomes different? (4 points)

origin (2 points) & insert size (2 points)

2 Initial attempt to perform PCR were carried out using the DNA polymerase from *E. coli*. Considering current PCR method, what could have been the major difficulty? (4 points)

thermostability of DNA polymerase at extension cycle

3 Why is the Sanger technique of DNA sequencing also called chain termination method? (4 points)

premature termination during DNA replication by adding dideoxy nucleotides (ddNTP)

4 What is the functional role of neuraminidase and hemagglutinin in Influenza virus? (4 points)

entry (key) and exit (knife)

5 List some characteristics used in classifying viruses.

Nucleic acid type, strandedness, the sense (+ or -) of ssRNA genomes, envelope, symmetry of capsid, dimension of the virion & capsid...

6 No temperate RNA phages have yet been discovered. How might this absence be explained?

Use what you know about DNA and RNA polymerization (primers, origins, etc.) in Cell; recombination of DNA (or RNA) into genome;

7 Why have many plant viruses not been as well studied as animal and bacterial viruses?

Difficult to cultivate and purify;
difficult to infect directly (need transmission vector; e.g. insect) or thick cell wall

8 Viral life cycle can be divided into several distinct steps. Discuss those steps relating to development of anti-viral drug.

Entry-propagation (early gene, late-gene)-packaging-Lysis(escape)

1. entry - inhibitor for the receptor recognition
2. propagation - inhibitors for replicase, protease, RT...
3. packaging & exit - inhibitors for packaging and neuraminidase...

9 There have been debate on the origin of life but now the RNA world hypothesis is mostly accepted by the scientists. Discuss pros and cons of the RNA world hypothesis.

pros - self-replicating (*in vitro*), enzymatic function (ribozyme), molecular fossil (e.g. similar to ATP & NADP..)

cons - unstable, no self-replication evidence

10 Why is rRNA so suitable for determining phylogenetic relatedness?

1. conserved in all living organisms (essential gene);
2. does not changed a lot during evolution (less mutations);
3. can be a molecular clock (constant mutation rate);

11 Following figure shows 'relative taxonomic resolution' (detection sensitivity) of various molecular techniques. What are those 4 techniques hidden (1~4)? (4 points)

Family	Genus	Species	Subspecies	Strain
1				
2				
	Mol% G+C			
	3			
		Multilocus sequence typing		
		Whole cell protein profiling		
		4		

1. genome sequencing; 2. 16S rDNA sequencing; 3. DNA-DNA hybridization

* Define or describe following terms (2 points each)

13 biovar & serovar

14 annotation

15 primer

16 prophage

17 stromatolites

18 metagenomics

19 cytopathic effects

20 protomers

21 type strain

22 lysogeny

23 molecular chronometer

24 early genes & late genes

25 ORF

26 restriction enzyme

27 tropism

28 virion

29 viroid

30 punctuated equilibria

31 southern blot & northern blot

32 isoelectric point

33 ortholog

34 paralog

35 anagenesis

36 Jaccard coefficient